



## DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

### 24 CFR PART 3285

[Docket No. FR-6023-N-01]

#### **Interpretative Bulletin for Model Manufactured Home Installation Standards Foundation Requirements in Freezing Temperature Areas under 24 CFR 3285.312(b)**

**Agency:** Office of the Assistant Secretary for Housing-Federal Housing Commissioner, HUD.

**Action:** Notice of Proposed Installation Interpretative Bulletin I-1-17.

**Summary:** The purpose of this proposed Interpretative Bulletin (IB) is to provide guidance for designing and installing manufactured home foundations in areas subject to freezing temperatures with seasonal ground freezing, in accordance with the Model Manufactured Home Installation Standards, wherever soil conditions are susceptible to frost heave. Specifically, this guidance is being provided for designing and installing manufactured home foundation systems in areas where frost susceptible seasonally frozen ground conditions are encountered and when footings do not extend below the frost depth at the site. These types of foundation systems include monolithic slab systems, “frost-protected shallow foundations” (FPSF) - insulated foundations, and alternative foundation systems that include foundation variations termed by industry as frost free footing systems or frost free foundations (FFF). Guidance is also being provided in this interpretative bulletin for installing manufactured home foundations, when non-frost susceptible soil conditions are available at the site to protect foundations against the effects of frost heave.

**DATES:** Comment Due Date: **[Insert date 60 days from the date of publication in the FEDERAL REGISTER].**

**ADDRESSES:** Interested persons are invited to submit comments regarding this Interpretative Bulletin to the Regulations Division, Office of General Counsel, Department of Housing and Urban Development, 451 Seventh Street, SW, Washington, DC 20410-0500. Room 10276, Washington, DC 20410-0500. Communications must refer to the above docket number and title. There are two methods for submitting public comments. All submissions must refer to the above docket number and title.

**1. Submission of Comments by Mail.** Comments may be submitted by mail to the Regulations Division, Office of General Counsel, Department of Housing and Urban Development, 451 7<sup>th</sup> Street, SW, Room 10276, Washington, DC 20410-0500.

**2. Electronic Submission of Comments.** Interested persons may submit comments electronically through the Federal eRulemaking Portal at [www.regulations.gov](http://www.regulations.gov). HUD strongly encourages commenters to submit comments electronically. Electronic submission of comments allows the commenter maximum time to prepare and submit a comment, ensures timely receipt by HUD, and enables HUD to make them immediately available to the public. Comments submitted electronically through the [www.regulations.gov](http://www.regulations.gov) website can be viewed by other commenters and interested members of the public. Commenters should follow the instructions provided on that site to submit comments electronically.

**Note:** To receive consideration as public comments, comments must be submitted through one of the two methods specified above. Again, all submissions must refer to the docket number and title of the rule.

*No Facsimile Comments.* Facsimile (FAX) comments are not acceptable.

**Public Inspection of Public Comments.** All properly submitted comments and communications submitted to HUD will be available for public inspection and copying between 8 a.m. and 5 p.m. weekdays at the above address. Due to security measures at the HUD Headquarters building, an advance appointment to review the public comments must be scheduled by calling the Regulations Division at 202-708-3055 (this is not a toll-free number). Individuals with speech or hearing impairments may access this number through TTY by calling the Federal Information Relay Service at 800-877-8339. Copies of all comments submitted are available for inspection and downloading at [www.regulations.gov](http://www.regulations.gov).

**FOR FURTHER INFORMATION, CONTACT:** Pamela Beck Danner, Administrator, Office of Manufactured Housing Programs, Office of Housing, Department of Housing and Urban Development, 451 Seventh Street, SW, Washington DC 20410; telephone (202) 708-6409 (this is not a toll-free number). Persons with hearing or speech impairments may access this number via TTY by calling the toll free Federal Relay Service at 1-800-877-8389.

**SUPPLEMENTARY INFORMATION:**

I. Background

The National Manufactured Housing Construction and Safety Standards Act of 1974 (42 U.S.C. 5401-5426) (the Act) as amended in 2000 authorizes the Department to establish Model Manufactured Home Installation Standards (Installation Standards) and establish an installation program to enforce those Installation Standards. The Installation Standards are at 24 CFR part 3285, and installation in freezing temperature areas is covered at § 3285.312(b). Section 604(a)(3) of the Act as amended in 2000 also created the Manufactured Housing Consensus Committee (MHCC). Section 604(b)(3) of the Act directs HUD to provide the MHCC with an

opportunity to review any HUD proposed Interpretative Bulletin and to provide written comments to the Department for a period of up to 120 days.

Frost-protected shallow foundations have been successfully used both domestically and internationally in residential and commercial applications for over 50 years as a means to avoid deeper and more costly foundation systems. However, as a result of recent problems and inquiries related to the proper design, use, and installation of manufactured home frost protected foundation systems in areas subject to freezing temperature conditions, HUD commissioned a study and report to assess both foundation design and installation practices for manufactured homes located in temperature areas with seasonally frozen ground. HUD provided the MHCC with a report of its findings on October 26, 2016, entitled “An Assessment of Design and Installation Practices for Manufactured Homes in Climates with Seasonally Frozen Ground” prepared by SEBA Professional Services, LLC (<https://portal.hud.gov/hudportal/documents/huddoc?id=10-07-16-Frost-free-Found.pdf>), and announced it would form the basis for an Interpretative Bulletin to be issued on the subject.

The study and resulting report found some key factors needed for long-term and consistent success require special considerations that are often neglected, particularly for FFF designs and installations that rely on well-drained and non-frost susceptible soil conditions. These factors include appropriately engineered installation details, site investigation practices, fulfillment of responsibilities by all parties associated with manufactured home installation, and verification procedures to ensure that important design conditions are actually being achieved in practice. Accordingly, this Interpretative Bulletin was developed for the purpose of clarifying requirements and providing practical guidance for the manufactured housing industry when

designing or setting foundations for manufactured homes in locations subject to freezing temperatures with seasonal ground freezing.

HUD also indicated at the October 26th meeting of the MHCC, that it would consider any comments received from the MHCC on the report and scheduled a teleconference on November 28, 2016, with the Regulatory Subcommittee of the MHCC and with the MHCC on December 12, 2016, to receive feedback and recommendations from the subcommittee and MHCC. As a result of those discussions, the Regulatory Subcommittee recommended that HUD draft an Interpretative Bulletin for the December 12, 2016, teleconference with the full MHCC, taking into consideration the comments from the Regulatory Subcommittee teleconference and subsequent comments from the MHCC. A large part of the discussion focused on what constitutes acceptable engineering practice. Some members of the subcommittee expressed concerns on whether the SEI/ASCE 32-01 (ASCE 32) Standard should exclusively define accepted engineering practice or if other engineering alternatives should be allowed. During the December 12, 2016, conference call with the MHCC, the committee developed and approved the following recommendations and comments to its draft Interpretative Bulletin. These comments were also approved by a subsequent letter ballot. The ballot results were provided to HUD by the MHCC's Administering Organization (AO) on January 23, 2017. HUD's response to each of the points raised by the MHCC is as follows:

1. Tone of the IB needs to be more positive.

HUD Response: A statement has been added above to indicate that frost protected shallow foundations have been successfully used both domestically and abroad for than 50 years.

2. The focus of the IB should be to inform and educate.

HUD Response. HUD believes that the IB focus is both informative and provides education to all respective participants in the installation process.

3. The IB should focus on compliance with 3285.

HUD Response: The guidance in the IB does focus on both foundation design guidelines and compliance with the provisions for foundations in freezing temperature areas in 3285.312(b) of the Model Installation Standards

4. The IB should be simplified (too lengthy).

HUD Response: HUD does not agree as the guidance cannot be further simplified in this proposed IB, since it is both practical and technical and, in general, provides a recipe for compliance with the Model Installation Standards.

5. FFF definition and FPSF definition.

HUD Response: A definition has been added for a Frost Protected Shallow Foundation (FPSF). However, as there is no generally recognized definition of a frost free foundation (FFF), HUD is requesting comments from the public on a suitable technical definition and has reserved a space in the IB for a definition of the term.

6. Clarify site specific foundation.

HUD Response: A site specific foundation means a foundation system that has been designed for a specific site.

7. Target audience should be installers, local jurisdiction, regulators, and manufacturers.

HUD Response: HUD agrees and focused the four options in the IB on those entities and organizations.

8. The problem doesn't seem to appear in all states and how to solve that problem.

HUD Response: Comments are being requested on other verifiable strategies that may not be addressed in this IB that have been effective and successfully used in other states.

9. Ensure additional cost are not incurred due to IB.

HUD Response: This IB has been developed to clarify the intent of the standards with technical concepts that will avoid costly foundation and structural repairs due to frost heave.

10. Reference to actual designs and specific engineering language in the IB should be removed.

HUD Response: Reference to actual designs has been removed from the IB. However, it remains necessary to utilize some engineering terminology to explain certain aspects of the foundation options contained in this IB.

11. Ensure IB doesn't exceed reasonable accepted engineering practice as required in § 3285.312(b)(2).

HUD Response: HUD believes that all aspects and options contained in this IB conform to acceptable engineering practice.

12. Remove reference to the SEBA report from the IB.

HUD Response: HUD agrees and has taken out the SEBA report.

13. Remove Local Authority Having Jurisdiction (LAHJ) where the plan approval is not required and in HUD administered states (§ 3286.3, HUD administered installation program) from the IB.

HUD Response: HUD does not agree with this recommendation as an LAHJ can both require plan approval and establish provisions which exceed the requirements of HUD's Model Installation Standards in states where HUD administers the installation program.

The MHCC also provided HUD with the specific suggested text revisions to the Interpretative Bulletin. The MHCC suggested revisions are available at <https://www.xxxxxxxx> (Appendix E). However, HUD did not agree with or accept the MHCC recommendation to delete the statement regarding the SEI/ASCE 32-01 Standard generally providing the bases for acceptable engineering practice (see page 10 of Appendix E); HUD consolidated MHCC recommendations for manufacturers on Recommended Practices and Procedures (see page 11 of Appendix E); HUD deleted the Recommendations for Retailers and Installers as recommended by the MHCC (see page 12 of Appendix E); HUD did not accept the MHCC recommendation regarding deleting statements regarding the assignment of design responsibilities to local authorities (see page 13 of Appendix E); HUD also did not accept the MHCC recommendation to delete the statement regarding submitting the foundation plan to the local authority having jurisdiction if applicable but did delete the statement regarding the sealing of foundation plans by an engineer or architect that is licensed in the state where the installation is occurring (see page 13 of Appendix E); HUD modified the language for regulatory officials and inspectors based in part on recommendations of the MHCC (see page 14 of Appendix E); HUD accepted the editorial revisions recommended by the MHCC for Option 1 (see page 15 of Appendix E); and HUD also accepted the MHCC recommendation to delete the requirements for vents in skirting to be automatically closing (see page 16 of Appendix E).

HUD has considered the above recommendations and comments from the MHCC and included them where it deemed appropriate in the text of the Interpretative Bulletin.



## II. The Interpretative Bulletin

This guidance is being issued in response to numerous requests, inquiries, and questions regarding how to comply with HUD's requirements for foundations in freezing temperature areas, in accordance with 24 CFR 3285.312(b) of the Model Manufactured Home Installation Standards, when footings do not extend below the frost depth at the site. Engineered foundations designs such as monolithic slab systems (§ 3282.312(b)(2)) placed on a layer of well drained undisturbed ground or fill material that is not susceptible to frost and frost protected shallow foundations (FPSF), which are insulated foundations (§ 3282.312(b)(3)) that rely on insulation to prevent ground freezing as well as other alternative foundation systems including industry termed "frost free foundations" have great appeal and potential in freezing temperature areas as a cost-effective means of installing manufactured homes on seasonally-frozen ground.

Understandably, their use has been promoted and increased in recent years as a means for reducing manufactured housing installation costs when compared to using conventional or proprietary foundation support systems in freezing temperature areas. However, some key factors important to their long-term and consistent success require special considerations that are often neglected, particularly for FFF designs and installations. These factors include appropriately engineered installation details, site investigation practices, and verification procedures to ensure that important design conditions are actually being achieved in practice.

Important factors or design considerations in any frost-protected foundation include:

- clarity of technical requirements;
- definite criteria for determining soil frost susceptibility and soil moisture sub-surface drainage conditions; and

- guidance on water table depth to determine if the site is suitably well drained.

In addition, for foundations being placed on non-frost susceptible soil, it is also necessary to provide guidance on appropriate site-specific details such as the depth of non-frost-susceptible soil or fill layers required for the frost depth encountered at the site and the layout of sub-surface drainage, when sub-surface site conditions are not well drained. Clarification and accuracy of roles during the site testing and installation process also play an important part in ensuring that frost-protected foundation designs meet the requirements of HUD's Manufactured Home Model Installation Standards in 24 CFR 3285.312.

The HUD commissioned study reviewed a selection of representative alternative foundation plans including FFF designs in current use for consistency with the HUD code, the ASCE 32 standard titled *Design and Construction of Frost Protected Shallow Foundations*, and generally accepted engineering practice. These reviews and additional technical information (including terminology and technical references) are included in an engineering assessment report at the URL provided in this notice. Thus, the report provides both a reference and technical basis for the guidance and recommendations included herein.

A summary of key findings from the engineering assessment are as follows:

- One of the reviewed FFF designs demonstrated an appropriate application of the HUD code and ASCE 32 standard's technical requirements for frost protection of foundations. Thus, it is possible to develop a compliant FFF design in accordance with acceptable engineering practice or ASCE 32.
- All other reviewed FFF designs contained a number of flaws or non-conformances, including:

- A lack of clarity of technical requirements in manufacturer installation instructions, details, and notes;
  - Missing or vague criteria for identification and measurement of soil frost susceptibility;
  - Missing or vague guidance for determining soil moisture, sub-surface drainage conditions, and water table depth in relation to determining if the site is “well drained” and suitable for an FFF installation; and
  - Missing guidance to direct appropriate site specific adjustments of important installation details (e.g., depth of non-frost-susceptible soil or fill layers and layout of sub-surface drainage when required).
- A number of the FFF installation designs reviewed showed a pattern of confused roles and responsibilities, often assigning design decisions and site engineering evaluations to local regulatory officials who are typically neither qualified nor trained in foundation engineering or soil mechanics and engineering. Furthermore, they are not charged with such responsibilities because it may pose a conflict of interest (i.e., enforcers making design and construction decisions or judgments on matters they will be enforcing) and a potential conflict with state engineering practice laws (i.e., conducting engineering or design activities for which they are not licensed). Consequently, this practice can lead to an incorrect selection of the proper foundation and drainage system for the site.

Consequently, most of the reviewed alternative foundation designs including FFF designs were found to be not in conformance with the HUD Code and the ASCE 32 reference standard for frost-protection of shallow foundations. In addition, one state’s installation rules were reviewed and provisions related to FFF design and installations were found to be similarly non-

compliant. Thus, a need exists to clarify requirements and provide guidance for proper and compliant applications of FFF designs as an alternative to a conventional (frost depth) footing or a conventional FPSF design using insulation to protect against ground freezing in accordance with acceptable engineering practice or the ASCE 32 standard.

In view of the above, each organization involved in the process of foundation design, approval, and installation has responsibilities that need to be met. Key areas and responsibilities for each organization or entity are as follows:

- Manufacturers need to ensure their foundation designs fully comply with 24 CFR 3285, Model Manufactured Home Installation Standards (HUD Code) by use of acceptable engineering practice or applicable provisions of the SEI/ASCE 32-01 Standard, Design and Construction of Frost-Protected Shallow Foundations (ASCE 32). In general, the basis and design principles for acceptable engineering practice should be consistent with the provisions of the ASCE 32 Standard. However, this interpretative bulletin is not intended to preclude the use of other alternatives such as engineered foundation designs provided they result in comparable protection against frost heave that would be provided by the ASCE 32 Standard.
- Manufacturers should review and, as appropriate, delete or revise any installation instructions that rely exclusively on surface drainage to prevent the effects of frost heave, as such installations do not comply with acceptable engineering practices or ASCE 32.
- Manufacturers should inform installers in their installation instructions and on all approved foundation plans that prior to beginning the installation, a site-specific soil test

or other evidence is required to determine soil frost susceptibility, the water table level, and sub-surface drainage conditions.

- Retailers should verify that the installations are performed only by licensed installers.
- Design professionals and Design Approval Primary Inspection Agencies (DAPIAs) need to ensure that foundation designs comply with all aspects of the HUD Code as provided in 24 CFR 3285.312. Designs that rely on surface drainage exclusively or do not specify the means of assessing frost susceptibility of soils and their sub-surface drainage characteristics should be disapproved or revised to meet the provisions of this Interpretative Bulletin. Frost protected foundation designs that were approved prior to the effective date of October 28, 2008, of HUD's Installation Program, should be reviewed and re-approved for compliance with 24 CFR 3285. Additionally, design and installation responsibilities may not be delegated to local regulatory authorities.
- Installers should consider all sites in freezing temperature areas as frost susceptible unless a soil test or other evidence is provided to prove the site is non-frost susceptible.
- To ensure compliance with acceptable engineering practices or ASCE 32, installers should never install a new home on a site that has conditions not covered in the manufacturer's installation instructions or the DAPIA approved engineered foundation plan, and should bring the specific site conditions to the professional engineer or registered architect of record for assessment or obtain the services of another professional engineer or registered architect to assess the site conditions and adequacy of the foundation design for the site. Once the plan is updated to address site conditions and sealed, it should be sent to the manufacturer and its DAPIA for approval. The plan

should then be submitted to the LAHJ, as applicable. Installers should not use any design that assigns responsibility to them for assessing frost susceptibility and sub-surface drainage conditions without proper soil analysis.

- Regulatory officials and inspectors should reject installation plans that require them to take on any aspect of design responsibility. If a site is claimed to have soil that is non-frost susceptible and that is well-drained, soil tests or other evidence must be provided to the regulatory official and/or inspector.
- Manufacturer's installation instructions including DAPIA approved engineered foundation plans should be available on-site during inspections. If these plans are not available, the home cannot pass inspection.
- In areas where no set local frost depth is determined, the depths corresponding with the Air Freezing Index (Figure 1) may be used.
- Installation rules in both states and local municipalities should be compared to the ASCE 32 standard and the HUD Code to ensure conformity.

In view of the above described concerns, this Interpretative Bulletin was developed for the purpose of clarifying requirements and providing practical guidance for the manufactured housing industry when designing or setting foundations for a manufactured home in locations subject to freezing temperatures with seasonal ground freezing. This guidance is intended for first-time installations, not replacement installs when current foundations exist on site.

In summary, in order to resolve the identified problems and previously discussed concerns in this Preamble associated with certain foundation designs and installation practices in temperature areas subject to freezing, all responsible parties in the process should follow the

guidance in this Interpretative Bulletin. These concerns and issues involve designers, DAPIAs, manufacturers, installers, and regulatory authorities. The most important factor in reducing problems are properly designed installation instructions giving appropriate direction and details for installers to implement and regulatory officials to verify and inspect. Because this overarching concern is applicable to all methods of installation related to foundation frost-protection, specific recommendations and guidance for various design and installation options are provided in the Interpretative Bulletin.

### **REQUEST FOR COMMENTS:**

HUD is soliciting comments from the public on the following:

1. How should the term frost free foundation be defined for use and context with this Interpretative Bulletin?
2. Are there any other alternative engineered foundation designs, including floating engineered slab designs and pile foundation systems, etc. that should be included for use with this Interpretative Bulletin? If so, under what conditions and criteria should these systems be permitted?
3. Please provide information on other strategies, that are currently not included in this proposed Interpretative Bulletin, that have been successfully used or employed to resist the effects of frost heave.

## **INSTALLATION INTERPRETATIVE BULLETIN I-1-17**

### **FOUNDATION REQUIREMENTS IN FREEZING TEMPERATURE AREAS**

This Interpretative Bulletin is being issued to provide guidance for all parties associated with designing and installing manufactured home foundation systems in areas subject to freezing temperatures in accordance with 24 CFR 3285.312(b) of HUD's Model Manufactured Home Installation Standards.

#### **Definitions**

Frost Free Foundation (FFF) [Reserved].

Frost Protected Shallow Foundation (FPSF) means a foundation protected from frost heave by insulating the foundation in accordance with acceptable engineering practice or with the provisions in SEI/ASCE 32-01, Design and Construction of Frost Protected Foundations (ASCE 32) to retard frost penetration below the foundation in order to allow shallower footing depths to be used. Use of well drained non-frost susceptible soils is also included as FPSFs for certain applications (i.e., monolithic slab systems, alternative foundations).

#### **I. Recommended Practices and Procedures**

The following recommendations, practices and procedures should be followed by all parties involved in manufactured home installations in order to ensure that foundations installed in freezing temperature areas are not subject to frost heave and comply with the provisions of HUD's Model Manufactured Home Installation Standards.

##### **1. Recommendations for Manufacturers:**

Manufacturers should require that design professionals who submit plans to them for approval, as required by 24 CFR 3285.2(c)(1)(ii), develop foundation frost-protection installation methods that comply with applicable provisions of the HUD's Model



Manufactured Home Installation Standards, 24 CFR 3285.312(b)(2) or (3). To ensure consistent and effective conformance, options with detailed guidance for complying designs are provided below and should be followed. These directions should also be incorporated into their Manufacturer's Installation Instruction manual as required by 24 CFR 3285.2(c)(2).

- Current Frost Free Foundation (FFF) installation instructions that rely exclusively on surface drainage as a means of foundation frost-protection should either be removed from the manufacturer's installation instructions or immediately revised.
- Manufacturer's installation instructions for monolithic slab and alternative foundation designs including FFF designs should indicate that, prior to commencement of installation, the steps to be taken to verify through soil tests or existing site soil records that the site soil is non-frost-susceptible and that a ground water assessment should be done to verify that the soil is "well-drained" with a water table depth consistently and sufficiently below the frost line.
- To facilitate installations in locations subject to freezing, manufacturer instructions should have at least one example of an acceptable foundation system for frost susceptible and non-frost susceptible soil conditions for use in freezing temperature areas. These designs are to have a design professional's seal, and if not previously part of the manufacturer's installation instructions, be approved by the manufacturer and its Design Approval Primary Inspection Agency (DAPIA).

## 2. Recommendations for Design Professionals and DAPIAs:

Foundation frost-protection methods used for installation designs need to comply with HUD's Model Manufactured Home Installation Standards by use of acceptable engineering practice or the ASCE 32 standard. To ensure consistent and effective

conformance, alternatives with detailed guidance for development of complying designs by manufacturers and for DAPIA review and approval are provided in the next section of this Interpretative Bulletin, “*Design Options, Compliance Checklists, and Installation Practices*”.

- Alternative foundation designs including FFF designs that rely exclusively on surface drainage as a means of foundation frost-protection should be removed from manufacturer’s installation instructions and its DAPIA approval withdrawn or be immediately revised.
- Alternative foundation designs that do not specify appropriate means of assessing the frost-susceptibility of soils and their sub-surface drainage characteristics on a site-specific basis should either be removed from use and the manufacturer’s installation instructions and DAPIA approval withdrawn or immediately revised.
- Alternative foundation designs including FFF designs that assign design responsibilities to local regulatory authorities, such as assessing site drainage, water table depth, or soil frost-susceptibility should be removed from use and the manufacturer’s installation instructions and DAPIA approval withdrawn or immediately revised.

### 3. Recommendations for Installers

When installing a new home on a site that has conditions not covered in the manufacturer’s installation manual or in a DAPIA approved alternative engineered foundation plan, the special site conditions should be brought to the attention of the engineer or architect of record. If there is no engineer or architect of record, a licensed engineer or licensed architect should be retained to evaluate the conditions and then

design a plan to install the home. Once this plan is finalized and sealed, it must be sent to the manufacturer and its DAPIA for approval per 24 CFR 3285.2(c)(1)(ii). The plan should also be submitted to the LAHJ for approval if applicable.

- Installers should never install manufactured homes using alternative foundations or FFF installation designs that rely exclusively on surface drainage as a means of frost protection.
- Installers should never initiate an FFF installation where the instructions require them to take on design responsibility of assessing soil frost-susceptibility and subsurface drainage conditions without proper soil testing and analysis. Instead, installers should verify that appropriate soil testing and site assessment for use of any given foundation design has been completed prior to initiating an installation.
- Prior to installation of an alternative foundation including an engineered system that is not included in the manufacturer's installation instructions, installers need to verify that the installation plan is stamped by an engineer or architect of record as well as approved by the manufacturer and its DAPIA.
- Installers should only use foundation plans that have been approved by the manufacturer and its DAPIA on or after January 1, 2009, the effective date of HUD's installation program.

#### 4. Recommendations for Local Regulatory Officials and Inspectors:

Regulatory officials and inspectors should verify compliance with manufacturer DAPIA approved installation designs including provisions for subsurface drainage, water table depth, requirements for non-frost-susceptibility of soils, etc., when required by the design for a given site.

- Where a site is claimed to have non-frost-susceptible and “well-drained” soils as a basis for setting foundation pads or footings above the design frost depth, evidence should be required including soils tests or pre-existing site-specific soil records and site sub-surface drainage and groundwater investigation by a qualified soils laboratory or soils engineering professional or geologist. Single site soil samples may be taken by the installer or by qualified soil engineering professionals with the soil tests done by a qualified soils engineering laboratory or soils engineering professional. The standard for non-frost susceptible soil is that no more than 6% by mass can pass through a #200 sieve in accordance with ASTM D422-63(2007)e2, Standard Test Method for Particle-Size Analysis of Soils (ASTM D422).
- Regulatory officials should assure that any DAPIA approved alternate foundation plans and the manufacturer installation instructions are on site and available during inspections. If approved installation plans are not available on site during inspections, the home cannot pass inspection.

In areas where the local frost depth is unavailable, or not documented, local regulatory officials should consider permitting design frost depths to be determined in accordance with Table 1. Design Frost Depth for Footings and Figure 1. U.S. Air Freezing Map Index.

## **II. DESIGN OPTIONS, CHECKLISTS AND INSTALLATION BEST PRACTICES**

### **OPTION #1: Checklist for Conventional Footings in Freezing Temperature Areas**

HUD Code, 24 CFR 3285.312(b)(1)

- Obtain the local-design frost depth for footings from either of the following:

- The local authority having jurisdiction (LAHJ),
  - Use Table 1 with the site's Air-Freezing Index (AFI) from Figure 1<sup>1</sup>, or
  - Consult with a registered professional engineer, registered architect, or registered geologist.
- When using Table 1 and Figure 1 to determine frost depth for footings, the depth of interior pier footings complying with footnote (b) of Table 1 may be taken as one-half the depth required in Table 1.
  - Based on the required frost depth for footings, dig the footing to the frost depth.
  - Check the soil bearing at depth of the footing with a torque probe, pocket penetrometer or other suitable testing device.
  - Based on the tested soil bearing value, properly size the footing according to the manufacturer's installation instructions or use the Table in 24 CFR 3285.202 in the HUD Code.
  - Place footing pads and construct piers or supports at locations specified in accordance with the manufacturer's installation instructions.
  - Backfill as needed and grade the site as required for drainage in accordance with 24 CFR 3285.203:
    - Crown the finish grade at the centerline of the foundation
    - Slope grade a minimum of ½-inch per foot for a minimum distance of 10 feet away from the home perimeter.

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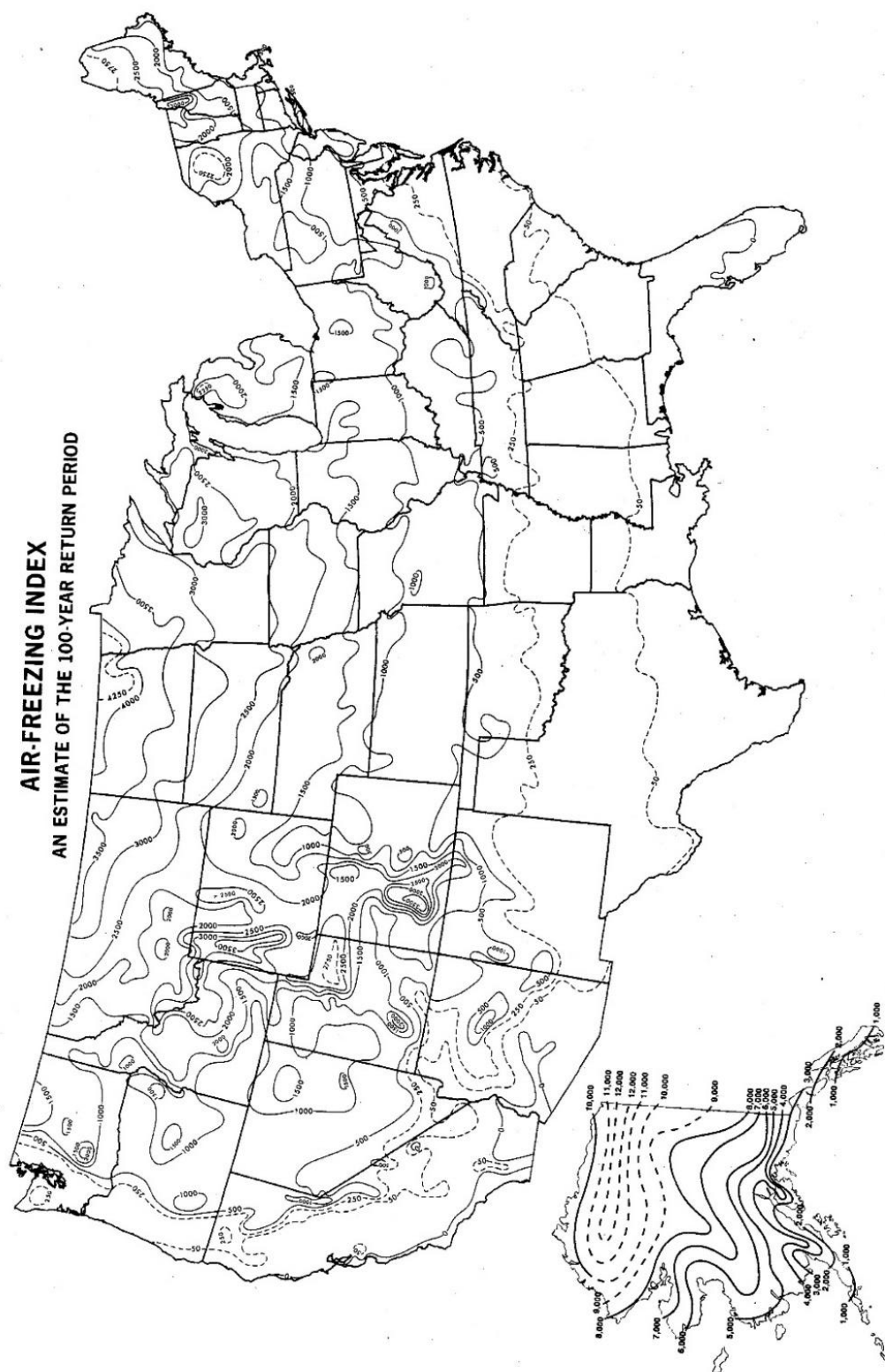
<sup>1</sup> A list of AFI values for various states and counties can be found in the 2015 International Residential Code (IRC), Table R403.3(2), published by the International Code Council, Inc., and used as the model building code for most states.

**TABLE 1. DESIGN FROST DEPTH FOR FOOTINGS<sup>a</sup>**

<b>AIR-FREEZING INDEX</b> <b>[See Figure 4]</b>	<b>MINIMUM DEPTH<sup>b</sup></b> <b>(inches)</b>
$\leq 50$	3
250	9
350	12
500	16
1000	24
1500	32
2000	40
2500	45
3000	52
3500	57
4000	62
4250	65

- a. These design frost depths are intended to be used for protection of building foundations against frost heave and are not applicable to site or street utilities or other non-building applications.
- b. These design frost depths for footings shall be permitted to be halved for footings interior to the building perimeter and located within an enclosed space. Where skirting is used to enclose the space, the skirting shall be insulated to a minimum R-5 (1000 to 2500 AFI) or R-10 (>2500 AFI) and vents shall be capable of

closing at outdoor temperatures below 40 °F (which necessitates use of a ground vapor barrier).



**Figure 1.** U.S. Air Freezing Index Map (based on Steurer, 1989 and Steurer and Crandell, 1995)



**OPTION #2: Checklist for Monolithic Slab Systems in Freezing Temperature Areas**

HUD Code, 24 CFR 3285.312(b)(2)

Pre-Installation Preparations:

- Before initiating installation, verify that the installation instructions are designed (sealed) by a registered professional engineer or registered architect, and approved by the manufacturer and its DAPIA.
- When applicable, verify that the LAHJ has accepted and approved the foundation and installation plan and all applicable permits are obtained. For designs that rely on well-drained sites and use of existing soils to frost depth that are non-frost susceptible, verify the following before initiating installation:
  - The non-frost-susceptible condition of existing soils above the frost depth and below the base of the slab at each site has been verified by site soil records or tested by a soils engineer or geologist or tested in accordance with ASTM D422 and determined to have a fines mass content of less than 6% by mass passing a #200 sieve for the specific installation site or the development as a whole. A soils report should be provided by the engineer or soil lab of record for verification.
  - Alternatively, conduct such testing as follows:
    - Obtain a minimum of two soil samples per installation site (one at each end of the foundation area) and from any borrow materials on site used as fill. A materials report from a quarry may be used when material is supplied from a licensed quarry.

- When conducting borings for soil samples, take a minimum of one pint (plastic bag full) of soil from depths of one foot and at the determined frost depth or at the frost depth as determined from Table 1, Design Frost Depth for Footings. Continue each boring to two feet below the determined frost depth (as measured from the proposed finish grade) to determine if the water table is present.
  - Deliver or send the soil samples to a soils laboratory for particle size testing per ASTM D422.
  - If the soils laboratory report indicates greater than 6% fines by mass passing a #200 sieve, then the soil at the site is frost susceptible and either footing to frost depth or one of the alternative foundation options (see <https://portal.hud.gov/hudportal/documents/huddoc?id=10-07-16-Frost-free-Found.pdf>) for frost susceptible soil conditions should be used.
- The water table condition of the site has been assessed by the engineer or architect of record and documentation provided of the water table being at least two feet below the determined frost depth. Alternatively, make this determination using soil borings as described above.
  - If the water table is higher than two feet below the determined frost depth, a network of drainage pipes sloped to drain to daylight or an engineered drainage system must be placed at the base of non-frost-susceptible fill (e.g., clean gravel or crush rock) placed to a depth equal to the local frost depth.

- Alternatively, a site specific foundation design can be prepared and sealed by a professional engineer or registered architect or geologist and approved by the manufacturer and its DAPIA. Such foundation designs are to comply with the provisions of the ASCE 32 Standard or with accepted engineering practice that will result in comparable performance to the frost protection afforded by the ASCE 32 Standard.
- Save documentation of all of the above and provide to the LAHJ for verification as required.
- For designs that rely on well-drained sites and use of fill materials to frost depth that are non-frost susceptible, verify the following before initiating installation:
  - The slab base and foundation fill materials are specified by the engineer or architect of record as non-frost susceptible such as clean gravel or crushed rock or other suitable material with no more than 6% fines by mass passing a #200 sieve per ASTM D422 test method. Non-frost susceptible subgrade materials are to be filled from the frost depth to the slab base for the entire extent of the slab plus any over dig.
  - The water table condition of the site has been assessed by the engineer or architect of record and documentation provided of the water table being at least two feet below the determined frost depth. Alternatively, this determination can be made using soil borings as described above.
    - If the water table is higher than two feet below the determined frost depth, a network of drainage pipe sloped to drain to daylight or an engineered drainage system should be placed at the base of non-

frost-susceptible fill (e.g., clean gravel or crush rock) placed to a depth equal to the determined frost depth.

- Save documentation of all of the above and provide to the LAHJ for verification as required.

Installation Phase:

- Excavate slab area to frost depth or only to the bottom of the slab's non-frost-susceptible base layer if existing soils have been determined to be non-frost susceptible down to frost depth during the pre-installation preparation phase (see above).
- Place foundation drains sloped to drain to daylight or an engineered drainage system at the bottom of the non-frost-susceptible base or fill material layer.
- Place the non-frost-susceptible fill and base materials, compacting as required by the manufacturer's installation instructions and/or the engineer or architect of record. Do not initiate fill placement where compaction requirements and methods are not specified. Obtain compaction requirements, as needed, from the engineer or architect of record. The minimum requirement is 90% compaction per 24 CFR 3285.201 although the engineer or architect of record or LAHJ may require a higher compaction level based on the fill material used.
- Construct the reinforced monolithic slab in accordance with the manufacturer's installation instructions or according to the manufacturer and DAPIA approved installation instructions and plans.
- Backfill as needed and grade the site as required for drainage:
  - Slope grade a minimum of ½-inch per foot for a minimum distance of 10 feet away from the home perimeter.

**OPTION #3: Checklist for Frost Protected Shallow Foundations (Insulated Foundations).**

HUD Code, 24 CFR 3285.312(b)(3).

Pre-Installation Preparations:

- Before initiating installation, verify that the installation instructions are designed (sealed) and certified by a registered professional engineer or registered architect, approved by the manufacturer and its DAPIA.
- Also, verify that the instructions include an approved installation design complying with one of the following bases for the proposed installation design, as permitted in the HUD Code:
  - Complies with acceptable engineering practice or the ASCE 32 standard by use of properly-specified insulation materials and sized in accordance with the local temperature area and located around the perimeter of the foundation with insulated skirting and closeable vents or the entire foundation pad is insulated where there is no skirting or the skirting is not insulated or the skirting has non-closing vents. Non-frost-susceptible base materials are used at a minimum thickness required by acceptable engineering practice or SEI/ASCE 32, and insulation materials are protected against damage in accordance with acceptable engineering practice or ASCE 32.
  - Complies with acceptable engineering practice to prevent the effects of frost heave in accordance with acceptable engineering practice or in a manner equivalent to the insulation provisions in the ASCE 32 standard.

- *NOTE: Designs which place insulation materials in a discontinuous fashion, such that exposed slab edges or other types of thermal bridging occurs, do not meet the requirements of the SEI/ASCE 32 standard or the HUD Code provisions that allow the use of “acceptable engineering practice to prevent the effects of frost heave.”*
- Obtain foundation insulation materials as specified in the installation instruction and verify the correct type is received. Commonly accepted insulation materials include Extruded Polystyrene (XPS) and Expanded Polystyrene (EPS) of various “types” in accordance with ASTM C578 and ASCE 32 standards.
- Insulation material conformance with the specified type should be verified by product labels or a certification from the insulation manufacturer. Materials commonly stocked in supply stores may not be the correct “type” even though it may be the correct “kind” (e.g., XPS or EPS).

*NOTE: There is no need to determine the frost susceptibility of underlying soils to frost depth in the insulated foundation design approach when the foundation and ground insulation provisions of ASCE 32 are satisfied.*

#### Installation Phase:

- Excavate the foundation area to the correct shallow foundation depth as indicated in the manufacturer’s installation instructions or by the engineer or architect of record (generally the foundation depth need not exceed 12” to 16” below finish grade).
- Place specified non-frost-susceptible base material and provide drainage pipes around the perimeter, at a minimum of 4 inches (within the base material layer) as required by the installation instructions. Pipes need to be run to day-light or have a mechanical means of

draining the water. Sequence the foundation slab or pad construction and insulation placement in accordance with the design approach indicated on the manufacturer's installation instructions. Where sub-slab insulation is required, this will need to be placed before slab construction. Perimeter insulation may be placed after slab construction.

- After construction of the slab and supports and placement of the home, construct the insulated skirting with closeable vents as required by the manufacturer's installation instructions. Where the foundation slab is entirely insulated with horizontal below ground insulation (the design does not rely on perimeter insulation only), no skirting is required.
- Place wing insulation (extending outward horizontally underground from the perimeter of the foundation) as required by the installation instructions. Depending on the design approach and temperature severity, wing insulation may or may not be required.
- Provide protection of any exposed exterior insulation or within 10 inches of the finish grade surface.
- Backfill as needed and grade the site as required for drainage:
  - Slope grade a minimum of ½-inch per foot for a minimum distance of 10 feet away from the home perimeter.

#### **Option #4: Checklist for Alternative Foundations on Non-Frost Susceptible Soils Including Frost Free Foundations**

HUD Code, 24CFR 3285.2

##### Pre-Installation Preparations:

- Before initiating installation, verify that the installation instructions are designed (sealed) by a professional engineer or registered architect, and approved by the manufacturer and

its DAPIA. The LAHJ can require that the plans also be reviewed and sealed by an engineer or architect in the state where the installation is to occur.

- When applicable, verify that the LAHJ has accepted and approved the alternative foundation and installation plan and all applicable permits are obtained. The installation design needs to comply with one of the following conformance options for the proposed installation design as permitted in HUD's Model Manufactured Home Installation

Standards:

- Complies with acceptable engineering practice or the ASCE 32 standard by use of non-frost-susceptible site soils or fills (adequately tested and verified as defined in ASCE 32) and that such soils or fills extend to the determined frost depth with provision for adequate surface and subgrade drainage especially where underlying soils are poorly drained and/or the water table is within two feet of the design frost depth.

*NOTE: Reliance solely on surface drainage to prevent the effects of frost heave without verification of non-frost-susceptible fill materials or existing non-frost susceptible soils to frost depth does not comply with the design principles of the ASCE 32 standard or HUD Code's allowance for "acceptable engineering practice to prevent the effects of frost heave."*

- For designs that rely on well-drained soils and sites and use of existing soils to frost depth that are non-frost susceptible, verify the following before initiating installation:
  - The non-frost-susceptible characteristic of existing soils above the determined frost depth at each site has been tested by a soils engineer or geologist or tested in accordance with ASTM D422 and determined to have a fines mass content of less than 6% passing a #200 sieve for the specific installation site or the



development as a whole. A soils report should be provided by the engineer or soil lab of record for verification.

- Alternatively, conduct such testing as follows:
  - Obtain a minimum of two soil samples per installation site (one at each end of the foundation area) and from any borrow materials on site used as fill. A materials report from a quarry may be used when material is supplied from a licensed quarry.
  - When conducting borings for soil samples, take a minimum of one pint (plastic bag full) of soil from depths of one foot and at the determined prescribed frost depth or as determined from Table 1, Design Frost Depth for Footings. Continue each boring to two feet below the determined prescribed frost depth (as measured from the proposed finish grade) to determine if the water table is present.
  - Deliver or send the soil samples to a soils laboratory for particle size testing per ASTM D442.
  - If the soils laboratory report indicates greater than 6% fines by mass passing a #200 sieve, then the soil at the site is frost susceptible and either a footing to frost depth or a manufacturer and DAPIA approved alternative foundation for frost susceptible soil conditions must be used.
- The water table condition of the site has been assessed by the engineer or architect of record and documentation provided of the water table being at least two feet

below the determined frost depth. Alternatively, make this determination using soil borings as described above.

- If the water table is higher than two feet below the determined frost depth, a network of drainage pipes sloped to drain to daylight or an engineered drainage system should be placed at the base of non-frost-susceptible fill (e.g., clean gravel or crush rock) placed to a depth equal to the determined frost depth.
- Alternatively, a site specific foundation design can be prepared and sealed by a professional engineer or registered architect or geologist and approved by the manufacturer and its DAPIA. Such Foundation designs are to comply with the provisions of the ASCE 32 Standard or with accepted engineering practice that will result in comparable performance to the frost protection afforded by the ASCE 32 Standard.
- Save documentation of all of the above and provide to the LAHJ for verification as required.
- For designs that rely on well-drained sites and use of fill materials to frost depth that are non-frost susceptible, verify the following before initiating installation:
  - The slab base and foundation fill materials are specified by the engineer or architect of record as non-frost susceptible such as clean gravel or crushed rock or other suitable material with no more than 6% fines by mass passing a #200 sieve per ASTM D442 test method. Non-frost susceptible subgrade materials are to be filled from the frost depth to the slab base for the entire extent of the slab plus any over dig.

- The water table condition of the site has been assessed by the engineer or architect of record and documentation provided of the water table being at least two feet below the determined frost depth. Alternatively, this determination can be made using soil borings as described above.
  - If the water table is higher than two feet below the determined frost depth, a network of drainage pipe sloped to drain to daylight or an engineered drainage system should be placed at the base of non-frost-susceptible fill (e.g., clean gravel or crush rock) placed to a depth equal to the local frost depth.
- Save documentation of all of the above and provide to the LAHJ for verification as required.

#### Installation Phase:

- Excavate area under foundation or slab to frost depth or only to the bottom of the non-frost-susceptible base layer if existing soils have been determined to be non-frost susceptible down to frost depth during the pre-installation preparation phase (see above).
- Place foundation drains sloped to drain to daylight or an engineered drainage system at the bottom of the non-frost-susceptible base or fill material layer.
- Place the non-frost-susceptible fill and base materials, compacting as required by the manufacturer's installation instructions and/or the engineer or architect of record. Do not initiate fill placement where compaction requirements and methods are not specified. Obtain compaction requirements, as needed, from the engineer or architect of record. The minimum requirement is 90% compaction per 24 CFR 3285.201 although the engineer or

architect of record or LAHJ may require a higher compaction level based on the fill material used.

- Construct the alternative foundation system in accordance with the manufacturer's installation instructions or according to the manufacturer and DAPIA approved installation instructions and plans.
- Backfill as needed and grade the site as required for drainage:
  - Slope grade a minimum of ½-inch per foot for a minimum distance of 10 feet away from the home perimeter.

*NOTE: The above procedures also apply to designs where a monolithic slab is not used and pier footing pads are placed directly on non-frost-susceptible soils or fill materials (e.g., clean gravel or crushed rock) to the determined frost depth.*

This Interpretative Bulletin is issued pursuant to 24 CFR 3285.2 and 3285.312(b) of HUD's Model Manufactured Home Installation Standards.

**Date:** June 15, 2017

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Genger Charles  
General Deputy Assistant Secretary for Housing

**[FR-6023-N-01]**

[FR Doc. 2017-12964 Filed: 6/20/2017 8:45 am; Publication Date: 6/21/2017]